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INTERNATIONAL PRELIMINARY EXAMINATION REPORT
(PCT Article 36 and Rule 70)

10/521395



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| Applicant's or agent's file reference 000677-0032 | FOR FURTHER ACTION | | See Notification of Transmittal of International Preliminary Examination Report (Form PCT/PEA/416) |
| International application No. PCT/CA 03/01070 | International filing date (day/month/year) 16.07.2003 | Priority date (day/month/year) 16.07.2002 | |
| International Patent Classification (IPC) or both national classification and IPC C12P3/00 | | | |
| Applicant CO2 SOLUTION INC. et al. | | | |

1. This international preliminary examination report has been prepared by this International Preliminary Examining Authority and is transmitted to the applicant according to Article 36.
2. This REPORT consists of a total of 7 sheets, including this cover sheet.
 - ☒ This report is also accompanied by ANNEXES, i.e. sheets of the description, claims and/or drawings which have been amended and are the basis for this report and/or sheets containing rectifications made before this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions under the PCT).

These annexes consist of a total of 5 sheets.

3. This report contains indications relating to the following items:

- I ☒ Basis of the opinion
- II ☐ Priority
- III ☐ Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
- IV ☐ Lack of unity of invention
- V ☒ Reasoned statement under Rule 66.2(a)(ii) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement
- VI ☐ Certain documents cited
- VII ☐ Certain defects in the international application
- VIII ☐ Certain observations on the international application

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|---|--|
| Date of submission of the demand 23.02.2004 | Date of completion of this report 05.11.2004 |
| Name and mailing address of the international preliminary examining authority:  European Patent Office D-80298 Munich Tel. +49 89 2399 - 0 Tx: 523656 epmu d Fax: +49 89 2399 - 4465 | Authorized Officer Jenn, T Telephone No. +49 89 2399-7348  |

**INTERNATIONAL PRELIMINARY
EXAMINATION REPORT**

International application No. **PCT/CA 03/01070**

I. Basis of the report

1. With regard to the **elements** of the international application (*Replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to this report since they do not contain amendments (Rules 70.16 and 70.17):*

Description, Pages

5-7

as published

1-4, 4a

received on 25.10.2004 with letter of 25.10.2004

Claims, Numbers

1-14

as published

Drawings, Sheets

1/2-2/2

as published

2. With regard to the **language**, all the elements marked above were available or furnished to this Authority in the language in which the international application was filed, unless otherwise indicated under this item.

These elements were available or furnished to this Authority in the following language: , which is:

- ☐ the language of a translation furnished for the purposes of the international search (under Rule 23.1(b)).
- ☐ the language of publication of the international application (under Rule 48.3(b)).
- ☐ the language of a translation furnished for the purposes of international preliminary examination (under Rule 55.2 and/or 55.3).

3. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, the international preliminary examination was carried out on the basis of the sequence listing:

- ☐ contained in the international application in written form.
- ☐ filed together with the international application in computer readable form.
- ☐ furnished subsequently to this Authority in written form.
- ☐ furnished subsequently to this Authority in computer readable form.
- ☐ The statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.
- ☐ The statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished.

4. The amendments have resulted in the cancellation of:

- ☐ the description, pages:
- ☐ the claims, Nos.:
- ☐ the drawings, sheets:

**INTERNATIONAL PRELIMINARY
EXAMINATION REPORT**

International application No. **PCT/CA 03/01070**

5. ☐ This report has been established as if (some of) the amendments had not been made, since they have been considered to go beyond the disclosure as filed (Rule 70.2(c)).
(Any replacement sheet containing such amendments must be referred to under item 1 and annexed to this report.)

6. Additional observations, if necessary:

see separate sheet

V. Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

| | | |
|-------------------------------|-------------|------|
| Novelty (N) | Yes: Claims | 1-14 |
| | No: Claims | None |
| Inventive step (IS) | Yes: Claims | None |
| | No: Claims | 1-14 |
| Industrial applicability (IA) | Yes: Claims | 1-14 |
| | No: Claims | None |

2. Citations and explanations

see separate sheet

**INTERNATIONAL PRELIMINARY
EXAMINATION REPORT - SEPARATE SHEET**

International application No. PCT/CA 03/01070

Re Item I

Basis of the report

Reference is made to the following documents:

- D1:** WO 98 55210 A (BLAIS R ;ROGERS P A (CA); SYSTEMES ENVIROBIO INC (CA)) 10 December 1998, **cited** in the application;
- D2:** DATABASE CA [Online] CHEMICAL ABSTRACTS SERVICE, COLUMBUS, OHIO, US; 12 August 1978, TABATA, H et al.: 'Separation of Calcium from a Solution Containing Calcium and Magnesium' Database accession no. 89:61929 XP2260760 & JP 52 138477 A (KINKAI KAISUI KOGYO KK) 18 November 1977;
- D3:** US-B1-6 387 212 (CHRISTIAN R) 14 May 2002;
- D4:** CA-A-2 352 626 (CO2 SOLUTION INC) 12 January 2003;
- D5:** SHIMOMURA, N et al.: 'Control of the production amount and polymorphism of calcium carbonate by biomimetic mineralization' CHEMISTRY LETTERS, vol. 31, no. 9, September 2002, pages 902-903, XP9019773.

The amendments filed with the letter dated 25.10.2004 introduce subject-matter which extends beyond the content of the application as filed, contrary to Article 34(2)(b) PCT. The amendments concerned are the following:
The recycling and reuse of the solution free of CaCO_3 as claimed in amended claim 11 (see enclosure) is not disclosed in the application as filed.

Therefore, the following Examination Report is given on the subject-matter of claims 1-14 as originally filed.

Re Item II

Priority

- 1 The priority document in respect of the present application is at present not available to the International Preliminary Examination Authority. In consequence the current assessment is based on the assumption that all claims enjoy priority rights from the filing date of the priority document. If it later turns out that this is not correct, the documents **D4** and **D5** cited in the international search report could become relevant.

- 2 Document **D4** discloses (the references in parentheses applying to this document) gaseous CO_2 emissions from processes such as hydrocarbon reforming are transformed into carbonate or bicarbonate ions and hydrogen ions by the enzymatic system in order to prevent their contribution to the greenhouse effect (Abstract, examples 1 and 2).
- 3 Document **D5** discloses (the references in parentheses applying to this document) the cooperation between carbonic anhydrase (CA) as a catalyst for the conversion of CO_2 to HCO_3^- , and poly(L-aspartate) as calcium ion recognition sites, induced the aragonite formation of calcium carbonate. The higher CA-arising activity promoted the calcium carbonate production (Abstract).

Re Item V

Reasoned statement with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. The application discloses (the references in parentheses applying to this document) a process for producing CaCO_3 comprising (1) catalysing the hydration of CO_2 contained in a gas by means of an enzyme (carbonic anhydrase), thereby producing a solution containing bicarbonate ions and hydrogen ions; (2) reacting the bicarbonates with calcium ions; and (3) precipitating the CaCO_3 obtained (claims 1-8). The application discloses as well an apparatus for producing CaCO_3 according to said process (claims 9-14).
- 2 The document **D2**, which is considered to represent the most relevant state of the art, discloses (the references in parentheses applying to this document) the formation of CaCO_3 by precipitation of the product obtained by mixing NaHCO_3 and dissolved Calcium (abstract).
- 3 The subject-matter of claims 1 and 9 therefore **differs** from this known process in that the CO_2 contained in a gas is first hydrated by means of a catalyst capable of catalysing the hydration of dissolved CO_2 into hydrogen ions and bicarbonate ions.
- 4 The subject-matter of **claims 1 and 9** and of their dependant claims **2-8** and **10-14** is therefore **new**. Claims 1-14 comply with the requirements of Article 33(2) PCT.

- 5 The **problem** to be solved by the present invention may therefore be regarded as to find an alternative way of forming calcium carbonate.
- 6 The **solution** proposed in claim 1 of the present application cannot be considered as involving an inventive step (Article 33(3) PCT) for the following reasons:
- 6.1 Document **D1** discloses (the references in parentheses applying to this document) a bioreactor/process for removing CO₂ from a CO₂-containing gas, characterized in that it comprises the step of: (a) contacting the CO₂-containing gas with an aqueous liquid in a bioreactor containing immobilized carbonic anhydrase or an analog thereof, the carbonic anhydrase catalysing the hydration of the CO₂, thereby producing hydrogen ions and bicarbonate ions (claims 1 and 9).
Thus by combining the process of **D1** to the teaching of **D2**, the skilled person would solve the problem posed without the exercise of inventive skill. Thus, the subject-matter of claims 1, 3, 5, 9 and 11 does not involve an inventive step and does not satisfy the criterion set forth in Article 33(3) PCT.
- 6.2 Document **D3** discloses a process for obtaining fibres integral with calcium carbonate particles, which comprises: preparing a first composition comprising calcium bicarbonate; preparing a second composition comprising calcium hydroxide; and mixing the first and second compositions in the presence of said fibres thereby precipitating calcium carbonate particles in contact with at least some of said fibres; Thus, the subject-matter of claim 2 is obvious for the skilled person;
Dependent claims 4, 6-8, 10 and 12-14 do not contain any features which, in combination with the features of any claim to which they refer, meet the requirements of the PCT in respect of an inventive step.
- 6.3 Therefore, the subject-matter of claims 1-14 does not comply with the requirements of Article 33(3) PCT.
7. The subject-matter of **claims 1-14** complies with the requirements of Article 33(4) PCT, because the process according to claim 1 and/or the apparatus according to claim 9 have an **application** for producing CaCO₃.

Further deficiencies of the Application:

- 1 Claims 1 and 10 do not meet the requirements of Article 6 PCT in that the matter for which protection is sought is not clearly defined. The claims attempt to define the

subject-matter in terms of the result to be achieved ("enzyme(s) capable of catalysing the hydration of dissolved CO₂ into hydrogen ions and bicarbonate ions") which merely amounts to a statement of the underlying problem.

2. Claim 9 does not meet the requirements of Article 6 PCT in that the matter for which protection is sought is not clearly defined. The following functional statements do not enable the skilled person to determine which technical features are necessary to perform the stated functions: "catalysing means", "reacting means", and "precipitating means".
3. The feature of claim 5, that an "enzyme" is immobilized, is not referred to in the description, which discloses that "carbonic anhydrase" is immobilized (page 5, line 23 and page 7, line 8). Claim 5 is therefore not supported by the description as required by Article 6 PCT.
4. All the feature of claims 9-14 are not referred to in the description. Claims 9-14 are therefore not supported by the description as required by Article 6 PCT.
5. There are spelling mistakes in the application:
Claim 1 and page 3, line 6: "charaterized"